of the ganglion at the apex of the circle.* The above-mentioned large mesial œsophageal ganglion, (brain,) sends off posteriorly another branch of much larger size, backwards along the abdominal surface of the animal, which closely adheres to the internal layer of its double envelope.

That these different filaments and ganglia, to which we have given the name of nerves, are not muscles, is evident from their form, their mode of insertion into the integuments, and because in the contractions of the animal they are not shortened, but assume a serpentine form, being apparently quite passive. They are not vessels, because no pulsation nor motion of a contained fluid has been hitherto perceived through their transparent tissues. If they are not organs of an entirely unknown nature, the whole analogy of their form and position, compared with that of the nervous system in other invertebrate animals, favours the idea of this being their true nature.

We may here consider as appendages to the nervous system, those coloured points situate in the anterior part of the head of these animals, and most usually on the dorsal surface, which have been considered as eyes. As already noticed, the first discovery of these organs was made in 1816 by Nitsch, who saw in the *Cercaria viridis*, (now referred by Dr. Ehrenberg to the genus *Euglena*,) three black scaliform points. In the *Rotifer vulgaris*, their pigment is of a red colour, and they are three in number, two small ones at its anterior extremity, and a single larger one at the nucha in the situation of the apex of the above-mentioned nervous circle in the *Hydatina*; and it is very probable that the two filaments, which in the latter animal are sent forwards from this ganglion, or even the ganglion itself, subserve the purposes of vision. The number, disposition, and colour of these points is the same in the *Eosphora najas*, where the mesial eye is still larger and more distinct. In the *Philodina erythrophthalma* their colour is the same, but they are only two in number, (the most common disposition in this class,) much smaller, and situate more posteriorly. In the *Lepadella ovalis* one only is visible of considerable size in the mesial situation of the large one of the Eosphora.

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2. *Attenuation of organized matter.*—Some idea may be formed of the high degree of attenuation of which organized matter is susceptible from the following facts. By Professor EHRENBERG's measurements, the *monas termo* does not exceed 1-1500 to 1-2000 of a line in diameter; and he states that the four stomachs did not occupy half the bulk of the animal. Each stomach must therefore be about 1-6000 of a line in diameter. Some of Professor Ehrenberg's observations tend to prove that the genus *monas* and some others are only the young state of some *kolpodæ*, *paramæciæ*, &c. But supposing them to be perfectly developed animals, and that their ova bear the same relation to the size of their bodies, which those of the *kolpodæ* do, that is, 40 to 1, we must conclude the existence of young monads which have a diameter of only 1-60000 of a line, or 1-720000 of an inch. Each of these monads must possess a stomach and organs passing in dimensions the power of numbers, and certainly giving us very magnificent ideas of the grandeur of organized nature.—*Ibid.*

PHYSIOLOGY.

3. *Physiological Investigations arising from the Mechanical Effects of Atmospherical Pressure on the Animal Frame.*—The weight of the atmosphere, though not constantly the same, varying from 1-12th to 1-15th of its whole weight,† on

* The best view of the disposition and appearances of the œsophageal ganglia, is got from the dorsal side of the animal, in a line with the great dorsal vessel. The nervous collar given off from the brain, is however best seen on a lateral view.

† These variations are gradual, so that it requires some days or weeks before the weight passes from one extreme to the other.

an average amounts to fourteen and a half pounds on each square inch of surface: and to this pressure the human body in common with all other objects is subjected. The whole surface then of a middle-sized person will have to support from fifteen to twenty tuns of pressure, all acting inwards and tending to compress the body into a less compass. Now the question arises, how is it that the animal frame is utterly insensible of the whole, or of any part of this enormous pressure upon it. Mr. DALTON, in a late volume, (Vol. X.) of the Manchester Memoirs, has attempted a solution of this question, and we shall lay before our readers the views he has presented.

It is pretty well known that the *specific gravity* of living men in general, is less than that of water.* Mr. Robertson, formerly librarian to the Royal Society, found that if ten men taken promiscuously, one of them was a little heavier than water, and two nearly the same weight as water; two others were only about .8 the weight of water—and the other five were of intermediate specific gravities. The average of the ten was—height, 5 ft. 6¼ ins.—weight, 146 lbs.—specific gravity, 1.891—bulk, 2.618 cubic feet. From this Mr. Dalton thinks that it may be safely inferred, that the body of a full-grown living man, when plunged over head in water, will be found to average nearly .9 of the weight of an equal bulk of water.

"It is remarkable," observes Mr. Dalton, "that all the component parts of the animal frame, as least of the human subject, are severally specifically heavier than the whole body, with the exception of air.—Bone, muscular flesh, blood, membrane, &c. are all heavier than water: animal fat is perhaps the lightest of the components, but even this is heavier specifically than the whole man upon the average.—Bone from the leg of a calf I found to be 1.24 specific gravity. The lean of beef, (raw,) I found 1.045 specific gravity.—Blood is from 1.03 to 1.05 specific gravity according to circumstances:—on the whole, the solid and liquid parts of the body, examined after life is extinct, would appear on an average to be somewhere about 5 per cent. heavier than water.

"That part of the volume of man which is exclusively occupied by air, and which may therefore be considered as adding nothing material to the weight of the body, consists of the air-tubes and air-cells of the lungs, the trachea or wind-pipe, the mouth and other appendages. It is not easy to ascertain the medium volume of air in the lungs of any individual! Messrs. Allen and Pepys found the air remaining in the lungs of a man after death somewhat exceeded 100 cubic inches. I found formerly that after a full inspiration I could blow out 200 cubic inches of air from my lungs, but was then quite exhausted. My ordinary inspirations and expirations amounted each to about 30 cubic inches.†

"Judging from the above facts and considerations I should be disposed to conclude that the medium volume of air in the lungs of a middle-sized person would not be less, but rather more than 100 cubic inches. Besides the lungs there are no other receptacles for air, I believe, in the body except the stomach and bowels, which are occasionally more or less inflated with portions of air either from the atmosphere or from other sources. If we allow 150 cubic inches for the volume of air, contained in the whole man when entirely immersed in water, it will be as fair an estimate perhaps as can be made. But it may be imagined by some that the whole substance of the body is pervious to air; that the skin, the flesh, the blood, and even the bones, may be imbued with air, somewhat in the same manner that water is, and yet have no cavities or cells in which the air is collected into a visible volume. Whether such an idea has ever been entertained or discussed I am not aware; but I presume no one has succeeded in determining either the nature or the quantity of the air so enveloped in the system. We shall now examine how far such a notion is countenanced by the preceding statement of facts.

"According to the preceding table of Robertson the average bulk of the ten

* Phil. Trans. Vol. 50.—Hutton's Dict. Sp. Gr.
† Memoirs Vol. II, (new series, p. 26.)

men was 2.618 cubic feet = 4500 cubic inches nearly; but of this volume 150 inches according to the above estimate were air, and the remainder 4350 inches were solid and liquid parts of the body. Now the average specific gravity of those parts of the body has been estimated above at 1.05 when examined as dead matter; this would make their weight equal to 4567 cubic inches of water; whereas it was found by actual weighing to be 146 lbs. as per table = 4044 cubic inches; hence the observed weight was less than the calculated weight, a portion equal to the weight of 523 cubic inches of water, or more than 1-9th of the whole weight of the body."

This discrepance demands investigation. Mr. Dalton thinks that it is not likely that Robertson's table of the specific gravities of men give too low an estimate; be this as it may, it certainly is not true as stated by him that the human subject generally floats in water *until the lungs become filled with that element.* Dr. Cullen in many dissections found no water in the lungs; and Dr. Goodwyn's experiments which are conclusive on this subject, show that only a very small quantity of water enters the lungs of drowned animals.* The specific gravities of the component parts of the body appear not to be overrated—and it will hardly be contended that the lungs of a middle-sized man will hold at a medium state of inflation six times the volume of air Mr. D. has assigned.

Upon the whole, Mr. Dalton is "inclined to believe the true explanation of the difficulty will be found in this, that the whole substance of the body is pervious to air, and that a considerable portion of it constantly exists in the body during life, subject to increase and diminution according to the pressure of the atmosphere, in the same manner as it exists in water: and further, that when life is extinct, this air in some degree escapes and renders the parts specifically heavier than when the vital functions were in a state of activity.

"The facts that water absorbs air of all kinds, that the quantity of air absorbed is proportional to the pressure and density of the gas, whether it be alone or mixed with other gases, and that certain laws of equilibrium take place, by which water acquires that state in which it is disposed neither to give out nor take in any more gas, have been abundantly proved by Dr. Henry and myself. M. Saussure has shown the like for other liquids, and for a great number of solid bodies. It may be seen too in my Chemistry, vol. 1st, page 236, that a bladder, which is generally considered as an animal membrane least pervious to air, may be filled with one gas, and being some time exposed to the atmosphere, it will be found to continue full blown as at first, but the contents will be chiefly atmospheric air. Messrs. Allen and Pepys in their ingenious and excellent essays on respiration, have proved that when a Guinea pig, or a pigeon is confined, for an hour, more or less, in a mixture of hydrogen and oxygen gases in proportion as 78 to 22, a large portion of azotic gas is found in the residue and an equal portion of hydrogen disappears. They ascribe this change to effects of respiration; but it appears to me more probably due to the principle we are advocating; namely, to the egress of azote from the whole body, and the ingress of hydrogen in lieu of it, in consequence of withdrawing the external pressure of the former and substituting that of the latter.

"When the palm of the hand is placed over the top of the receiver of an air-pump, and the air is exhausted, the pressure of the air on the outside is scarcely felt, but the inside is swollen and feels as if it was drawn or sucked into the receiver. Thus the sensation is on the inside and not without; the reason is, there is no change of pressure on the outside; but there is within, and the consequence is a tendency of the air in the hand to escape into the receiver, which occasions the pain and swelling. It is thus also that the issuing of blood in the surgical operation of cupping is effected.

"Though it does not seem of much consequence what the pressure of the air may be on the animal frame, within certain limits, yet sudden changes must al-

* See article Asphyxia in the forthcoming Medical Cyclopedia.

ways be accompanied with uneasy sensation. Climbing mountains, or ascending in a balloon, removes a part of the atmospheric pressure from the body; this causes the air in the body to tends outwards, and sometimes occasions bleedings. To supply oxygen to the lungs a greater volume of air must be breathed, and this seems to produce an acceleration of the pulse. On the other hand, by descending thirty or forty feet deep into water in a diving bell, the pressure of the air upon the body is increased inwards; pains in the ears are felt from the difficulty of suddenly restoring a disturbed equilibrium; but if the descent is slow and interrupted, time is given for the air to enter the pores, and the pain is less sensible. To what limit warm-blooded animals could bear the rarefaction of air so as to subsist, has not, that I am aware of, been determined with much precision. Ascents in balloons have been made till the atmospheric pressure was reduced more than one-half. Formerly I found that a mouse could subsist in air of $\frac{1}{4}$ of atmospheric density, and seemed not to have suffered much; but upon reducing the density below $\frac{1}{4}$, the animal was convulsed and expired immediately, notwithstanding the air was instantly admitted.

"If the view we have expanded in this essay, in regard to the action of aërial pressure on the animal frame, be correct, it may be inferred, that the pressure admits of great latitude; perhaps an animal could subsist under the pressure of $\frac{1}{2}$ an atmosphere, or of 3 or 4, or more atmospheres. The uneasiness and danger would be found in the quick transition. If time is allowed for the air to enter the body, and to escape from it, the transition is gradual, and the sensation arising from it imperceptible. The animal economy would be adapted to it, like as in the transition from a cold to a warm climate. It may hereafter be found, what length of time is sufficient to adjust the equilibrium, and whether this subject is any way connected with certain diseased states of the body. As far as regards the absolute pressure on the body, and our insensibility of it generally, this question will be met by the argument, that the air within the body, by its elasticity, sustains a corresponding pressure from without; but this only accounts for our alleviation from a small fractional part of the whole exterior pressure. The greater part must still be supported by the body; and we must have recourse to the great incompressibility of matter, to account for our insensibility of pressure. Canton found that water, pressed by one atmosphere more than ordinary, only exhibited a reduction of 1-21740th part of the whole; if the same rate, applied to the compression of the human body, the reduction or compression of the size of a man, 4500 cubic inches, would only be 1-5th of a cubic inch, for the weight of an additional atmosphere. Now as the body consists of solids and liquids of almost incompressible matter, and there is only a small part of the volume consisting of elastic fluid that is compressible, no material change of volume can take place, but on the sudden transition from one atmospheric pressure to another; and unless a change of volume take place, we cannot feel any pressure, either inward or outward. The phenomena of the water-hammer show, that the particles of water are hard, as they strike each other like flint and steel; and it is exceedingly probable that other bodies, solids as well as liquids, are constituted in like manner. A general pressure on the system then, only increases in a small degree the attraction of the ultimate particles, and it is met by a corresponding increase of repulsion from the atmosphere of heat; so that the system remains, as nearly as possible the same, and unaffected by such pressure."

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4. *Quantity of Food taken by a Person in Health compared with the Quantity of the different Secretions during the same period.*—The Fifth Volume of the *Memoirs of the Literary and Philosophical Society of Manchester*, contains an account of a very interesting series of experiments on the quantity of food, taken by a person in health, compared with the quantity of the different secretions during the same period; with chemical remarks on the several articles; by JOHN DALTON, F. R. S. The first series of experiments was made upon himself, in the month of March, for fourteen days successively. The aggregate of the